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Biodiversity Hot Spots in North Affica

by

Samir I. Ghabbour,

Introduction

It is well recognized that conservation of environment and wildlife (expressed as conservation of species, of ecosystems, or of habitats), is in fact conservation of biodiversity as well. But decisions on allocation of land for nature conservation are made on pragmatic rather than on scientific grounds. These include lower land suitability for agriculture, remoteness from urban or industrial development, general perceptions, etc. It is also quite impossible to conserve all species in reserves. A very large number of reserves will be needed to secure conservation of the entire biological diversity over the whole territory of a given country (Margules et al. 1988).

Policy oriented measures now must include the consideration of"hot spots", primarily based on the number of "endemic" species in a given site, and comparing the sites together. This concept is related to the use of indicators for assessing and monitoring biodiversity in an economical way (Pearce and Moran 1994). Noss (1990) proposes to carry out biodiversity monitoring schemes in 10 steps, the fourth step being the identification of hot spots and ecosystems at high risk. These are areas of"concentrated" biodiversity (e.g., centers of species richness and endemism) as well as ecosystems and geographical areas at high risk of

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(*) Dept. of Natural Resources, Inst. of African Research and Studies, Cairo University, 12613 Giza (Cairo), Egypt impoverishment due to anthropogenic stresses. Such areas warrant more intensive monitoring.

Endemism

An endemic species is defined as one whose geographic range is below a specific size or confined to a specific area. The minimum area used to define endemism varies greatly depending on the purpose of the definition, but may range from 'continental endemics' that are limited to a particular continent, to 'extreme local endemics' that are found in only a single site, such as a mountain top or an island. Desert oases are similar to islands in being "centers of endemism', when they harbour a certain number of endemics. Oases share with islands the property that they are isolated by immense distances of an alien environment, and island theories can apply to them to a great extent. The characteristics of centers of endemism, and of the endemic species themselves, should provide insights into conditions that allow the survival of endemic species, if not the origin of these species. The most obvious and best known centers of endemism are isolated oceanic islands. In light of accepted theories about island biogeography, patterns of dispersal, genetic isolation, and speciation, it is not surprising that certain islands have high levels if endemism. However, even within an island, the distribution of endemic species is often restricted to extremely small areas that are unusual in some way (Huston 1994).

Hot Spots

The term "hot spots" has recently been introduced into talk about biological diversity to mean areas or sites to which attention should be directed for priority action because of their sensitive situations. The IUCN North Africa Biodiversity Project had a component for the identification of such hot spots in the five countries of North Africa, in order to draw the attention of decision makers to devoting conservation efforts to these sites as a priority. This component includes field surveys, establishing a database, networking, workshops, and awareness, training, and media programmes. It will hopefully end up by giving a number of solid recommendations to decision makers in these five countries, for regional cooperation in conservation of North African biodiversity, before it is forever vanished due to aggressive "development" projects in such a fragile environment.

Soulé and Kohm (1989), in their edited report of a meeting of experts in conservation biology, conclude that there is a pressing need for surveys and mapping to resolve the spatial pattern and scaling of biological diversity in each of the world's principal biogeographic regions. Only through such a concerted mapping effort will biologists be able to locate centers of endemism, diversity "hot spots", and distinctive biotic formations associated with unusual soil or hydrological conditions. Such information is a vitally needed prerequisite for rational planning and for the preservation of biological diversity. Without such information, conservation can only shoot in the dark. Maps and accompanying materials should be available within each country to be used to identify major hot spots of diversity and endemism and eventually make specific recommendations for preservation.

The idea of applying the hot spots concept to the five North African countries: Egypt, Libya, Tunisia, Algeria, and Morocco, was first launched at the Meeting of the National IUCN Committees of these countries in Cairo, in November 1994 (Batanouny and Ghabbour 1996). An explanatory document was presented to IUCN (Batanouny and Ghabbour 1995) and the idea was discussed at the meeting in the Marrakesh Workshop in April 1995. The present paper is destined to clarify the concept, to give examples, and to propose a methodology and recommendations.

Definitions

There are several definitions for the term "hot spots" depending on what is needed by the person (or persons) using it. At the present stage of information about North African biodiversity we shall adopt the simple working definition given by Myers (1990), whereby hot spots are those areas that :

(a) feature exceptional concentrations of species with high levels of endemism, and

(b) face exceptional threats of destruction. He surmised that this approach could serve as a key contribution to conservation strategies.

Identification of areas to be protected requires setting priorities and listing areas of high and not so high biodiversity in an order of urgency, showing which are to be protected first and which can wait for some while. After completion of surveys of literature, of museum specimens, and of field excursions, which require time and personnel, GIS systems will provide opportunities to manage the large amounts of data that is necessary, and that is stored and manipulated in a data bank. Through a series of overlay maps, data can be manipulated to show:

1- areas of high species concentration,

2- of high rates of endemism,

3- of a high number of rare species, and

4- being unique habitats.

Through GAP analysis, areas can be identified that can serve as preserves for biological diversity (Scott et al. 1993). A series of smaller preserves are thought to be as effective in maintaining biodiversity as one large preserve, especially if they are interconnected by corridors. Preserves must be selected to protect biodiversity for long periods in the future (Anderson et al. 1993). Preserving maximum biological diversity in a given biological domain will require a network of reserves, which includes every possible species lor the longest period of time. This is called "permanent protection". Special algorithms are used that define the smallest number of sites which would include all the species to be preserved (Margules et al. 1988). We may add a few remarks to this approach, from the viewpoint of conservation efforts destined to conserve biodiversity in the arid lands of North Africa, namely the Great Sahara Desert. Needless to emphasize or to repeat that this is an immense hot and dry arid area, the largest of its kind in the world. The Sahara Desert may be poor in number of species, compared to other better endowed parts of the world (Cailleux 1953), but there are two remarks to be made:

1 - Those species that are present and which have survived for thousands of years are certainly very hardy and can tolerate extremes of temperature, from below zero to more than 50° C, and of water availability from desiccation to inundation. Such extremes are not encountered by other species anywhere else in other ecosystems.

2 - Desert species may be few, but they are certainly of an exceptional quality. However, most of the Sahara is barren, and when we consider that plants and animals are restricted in their distribution to the rare wadis, oases, wetlands, etc., the density of species, or species richness (number of species per unit area), or "species richness by area", will be much higher than indicated by these maps. As a matter of fact, where there are plants and animals in the desert is where there is water, and is where man can live. As such, these plants and animals, and their locations, are much valuable for innumerable economic uses that desert people are quite aware of. Consequently, the search for hot spots must be intimately linked to the search for indigenous knowledge about plants and animals inhabiting the desert.

The Problématique

On the basis of the foregoing, we should formulate the problèmatique of biodiversity conservation in North African deserts as one of quality rather than one of quantity. The number of species as such is a good criterion to consider, but the value of species in a community having a small number of species is not a measure of the value of that community, because every species in that small community is valuable in itself. Moreover, the small numbers of species in desert communities are an even more powerful argument for their conservation, because if, say, 10 species are to be lost out of a community of say one hundred species, this would be equivalent to the loss of 100 species from a community of 1000 species, which if in the tropical rain forest, would be considered catastrophic. Smaller numbers of lost species in desert ecosystems mean higher percentages of loss. The criterion therefore should be in terms of percentage loss rather than loss of sheer numbers. The Saharan species are too few, and too valuable, for us to allow them to disappear (Batanouny 1995 a and b, Ghabbour 1996).

Threats to Hot Spots

Wherever there is "land reclamation", tourism development, safari rallies, etc., hundreds of desert species and habitats are unknowingly threatened by disappearance because of such irresponsible and inattentive activities. Based on this, every part of the Sahara is, in a sense, a hot spot, because all desert species are valuable, are threatened, and are concentrated in the very few favourable spots where some moisture is permanently or intermittently available such as oases, wadis, depressions, mountain tops, coastal zones, and wetlands. If we take the example of Egypt, we can easily identify such hot spots in the Mediterranean coast, the desert fringe east and west of the Nile Delta and the Nile Valley, the shores of Lake Nasser (highly coveted by investors), the oases of the Western Desert, the wadis of the Eastern Desert, and the mountains of Sinaï, the Red Sea, and Gebel Oweinat (or Uweinat) in the south west corner of Egypt. Let us also add to these areas the several palm grove oases known throughout the region, where very ancient life styles and traditional ways of managing their agro-ecosystems are still being practiced, conserving their biota for an unknown while, till "development" schemes come their way (Barakat 1995). Thorough identification of similar hot spots in the other North African countries should help these countries in coordinating a cooperative regional strategy for the conservation and rational management of such hot spots. Ayyad and Fakhry (1994) found that building summer resorts along the coastal Mediterranean desert of Egypt caused a dramatic decrease in both richness and diversity of plant species, while Ahmad and Hussein (1994) showed in the same area that highest diversity (highest evenness and lowest dominance) was in heterogeneous sites with variable amounts of moisture availability. Fallow fields (high levels of disturbance) had lower diversity. Lower species richness and lower diversity were associated with higher aridity.

Origins of Biodiversity in North Africa

The geographical position of North Africa, situated on the fringes of the Earth's great biomes, particularly those of the Old World, has had an important role in the intermediate nature of its biodiversity. The Old World's biogeographic regions are four :

1- The Palaearctic, extending from the Iberian Peninsula to the Far East,

2- The Ethiopian, constituted of Africa south of the Sahara, plus Yemen,

3- The Oriental, extending from Oman to South East Asia, and separated from the Palaearctic by the Caucasus and Himalayas, and

4- The Australasian, constituted of Australia, New Zealand, and Pacific Ocean Islands.

North Africa is thus bordered by the Palaearctic from the north, the Ethiopian from the south, and the Oriental from the east. The Palaearctic Region extends into the coastal parts of Syria, Lebanon, Palestine, a very narrow strip along the northern coasts of Egypt and Libya, and the east and north of Tunisia. It occupies the Atlas Mountains in Tunisia, Algeria, and Morocco. The Oriental Region has limited extensions into the inner lands of Syria, Palestine, and Jordan. The Ethiopian Region may be considered as extending to the Tibesti and Hoggar Mountains, as well as southern Morocco. The Sahara Desert is a meeting place of elements from the Palaearctic, the Ethiopian, as well as some from the Oriental biogeographic regions, in varying combinations. It can thus be considered a transitional region, but neither a distinct biogeographic region nor a region divided among all three neighbouring regions.

If the North African desert is not a distinct biogeographic region, its biodiversity is certainly distinct just because it combines biotic elements from three different and distinct biogeographic regions. These are particularly the elements that have been selected from the species of the three regions and have become adapted over millions of years to the prevailing harsh desert conditions. There are also many species that have become isolated from such a long time that they evolved into new species that remained confined in the very small spots where they evolved, i.e., they are endemic species. The longer the isolation of these spots, the more should we expect to find endemic species therein.

Scientists have found, from earlier biogeographic studies, that certain Palaearctic species exist in North African oases, away from the Mediterranean coast, such as those in northern Libya and northern Egypt, and even as far south as Bilma Oasis in Chad and in the Tibesti and Hoggar, while Ethiopian species are found also in the Oases of northern Libya and northern Egypt, very near to the Mediterranean coast. It is noteworthy that most of the Palaearctic species that succeeded to reach the middle of the Sahara from the north are terrestrial. The possible exception, for example, being the amphibians of Morocco, which are all Palaearctic (Pasteur and Bons 1959), and a few semi-aquatic oligochaetes. By contrast, most Ethiopian species that succeeded to penetrate the Sahara and reach the Mediterranean coast are aquatic, with the help of the Nile, such as in the cases of aquatic oligochaetes (Ghabbour 1996), and of dragonflies (Dumont 1980), which will be further explained below, but also with the help of past Pluvial Periods, such as the dwarf crocodiles of the Hoggar.

Plants in the North African desert have two main centers rich in endemic species. The first is Egypt and Libya on one side and the second is Algeria and Morocco on the other side, separated by the desert of Syrte where the desert touches upon the seacoast. Most of the plants of the North African desert came to it along the terrestrial bridges connecting it to the neighbouring lands. We can distinguish the Irano-Turanian from the east, the Deccan from the southeast, the African from the south, the Andalusian from the northwest, the Sicilian from the north, and finally the Euro-Alpine from the northeast. North African desert plants comprise about 55% of Mediterranean origin, 35% of tropical origin, and the rest of Asiatic origin (Le Houérou 1995) .

The same aspect is observed in the ease of animal life. The Asiatic bear, lion, and auroch, existed in Syria and Palestine in historical times, and the wolf apparently never crossed to Egypt, but many reptiles of Asiatic origin populate the Eastern Desert of Egypt. At the same time, many Ethiopian species extend in Egypt along the Red Sea Mountain chain to as far as Suez in the north, but are more conspicuous in Gebel Elba, in the south-east corner of the country. The African cheetah was found in the Qattara Depression and exists also in Libya, Algeria, and Morocco (a special component of the IUCN North Africa Biodiversity Programme is devoted to it). North African cheetah populations are completely isolated from those of Central Africa.

The question now is how and when did the migrations of plants and animals from outside the North African desert into it did occur? To answer this question, we must look into the rather recent palaeoclimates and the geological history of the North African desert.

Origins of the North African Biota

In order to find out at which periods and under what conditions all these plants and animals reached the North African desert, we must go back to the relatively recent geological past of the region and the succession of Pluvial and Inter-pluvial Periods that occurred in it since the Miocene. Scientists can now distinguish between two types of fauna in the Ethiopian Region of Africa south of the Sahara, the forest fauna and the savanna fauna, which is more recent in its origination. During the Miocene (25 Million years to 12-15 Million years ago), the equatorial rain forest covered most of Africa. This great forest extended into the Arabian Peninsula, India, and southeast Asia in one continuous and homogeneous unit. Thus plants and animals were almost similar all through this immense space. This is the explanation for the similarity of many species of the Ethiopian and Oriental

Regions, where we can see similarities in elephants, leopards, rhinoceroses, primates and higher apes, etc.

The pluvial conditions of the Miocene and the early Pliocene were followed by dry conditions, and much of the rain forest disappeared so that the fauna of African forests was isolated from that of the Asian one. But this Pliocene dry period did not last for a long time and was followed by another rainy period, whereby the rain forest started to extend again. These changes did not only affect mammals, but also other vertebrates and the invertebrates. With the end of the Pliocene, since about 2 Million years, great changes in the global climate occurred. These resulted in the Ice Ages, which ended about only 11000 years ago. These Ice Ages (Glacials), and the Interglacials that alternated with them, explain the present day distribution of the flora and fauna in the North African desert (Cloudsley-Thompson 1969).

Several species of plants and animals migrated from Europe to Africa, especially over the Gibraltar Strait, to escape the ice. The formation of the ice sheets in the boreal regions resulted in a cooling of the global climate by about 5° C, higher rainfall, and a lowering of the sea level. The climate of North Africa was therefore more or less similar to the climate of southern Europe now, and land bridges between the two Continents appeared and facilitated plant and animal migrations. The Sahara was a large grassland that allowed easy intermingling of European and African biota, and enabled the first to reach the Tibesti and Hoggar Mountains, and the latter to reach the Mediterranean coast. When the last Glacial subsided (coinciding with the Neolithic period of human cultures), and the Sahara became dry, such plants and animals could survive and continue to reproduce only in spots having either permanent water, such as in the oases, or enough moisture, such as mountain tops. These are now regarded as "relict" species, i.e., cut off from their main populations in their original homes. Their presence, and their discovery, throws much light on the past history of the region and on its palaeo-ecology. However, when we look at the map of sites where were found fossils of larger mammals which go back to the Neolithic period (Allard-Huard 1994), we find that they all stop et the Tropic of Cancer, except for two sites in the Fayoum (Egypt) end Cyrenaica (Libya). This means that even during the supposedly relatively wet Neolithic, conditions for the fossilization of larger mammals were not favourable north of the Tropic of Cancer, except in the case of some species which could take advantage of the Nile stream and travel from it nearer to the Mediterranean coast to Fayoum and to Cyrenaica.

Bousquet (1992) shows a longitudinal transect between Algeria and Nigeria, across the western part of North Africa, whereby it can be seen how larger mammals are distributed along that transect, and how they are thinned out between the Mediterranean and the Sahel. Areas where the few large mammals exist in-between these two ecosystems should be considered as important potential hot spots. The same author shows some other hot spots in the Maghreb countries that serve as resting stations for migratory birds of the Western Palaearctic (Bousquet 1992), which also need attention. However, no matter how much it may be important to consider hot spots related to mammals and birds, as they are more conspicuous and attractive in the public eye, attention should also be directed to hot spots related to invertebrates, which constitute about 95% of the Animal Kingdom. Saharan invertebrates deserve protection as agents of soil fertility, natural enemies of pests, pollinators, among other ecosystem functions which they perform. Aniskowicz (1995) suggests that their protection should follow three steps:

1 - identification of non-vertebrate species at risk,

2 - protect these species and their habitats, and

3 - establish a central database to assist in the two preceding tasks.

The following two examples concerning earthworms and dragonflies will serve to illustrate the importance of giving attention to invertebrates in our quest for the conservation of biodiversity in the Sahara and the location of its hot spots.

The Example of Earthworms and Their Aquatic Allies

If we take the example of one group of invertebrates, to show us the origin of biodiversity in the North African desert, and how it came about, let it be the earthworms and their aquatic allies, which belong to Class Oligochaeta, Phylum

Annelida. Ghabbour (1994) has shown that there were several routes of entry to North Africa:

(1) From the Iberian Peninsula across the Strait of Gibraltar,which was divided into two directions, one eastward to Algeria, and the other along the Atlantic coast. Species of this group are terrestrial.

(2) From Sardinia and Sicily to Tunisia, which also branched into two directions, one westward to Algeria, and the other eastward to Libya and Egypt. This route ended in Siwa Oasis, the northwestern Mediterranean coast of Egypt, and the western fringe of the Nile Delta. The species of this group are all terrestrial, except one that is semi-aquatic.

(3) From the Balkans, along Turkey, Syria, Lebanon, and Palestine, and reaching the eastern fringe of the Nile Delta. Species of this group are terrestrial.

(4) From Central Africa, with three sources that benefited from the Nile stream: (a) one from Kenya, (b) the second from the Great Lakes Plateau (Tanzania, Uganda, and southern Sudan), and the third (c) from West Africa. Some species which used these migration routes reached Selima Oasis in the northern Sudan, Kharga, Bahariya, and Siwa Oases in Egypt, and the Oases of Cyrenaica and Tripolitania. Species of this group are aquatic and some are semi-aquatic. A fourth source (d), along the Blue Nile, did not continue further north of the area of Khartoum (Ghabbour 1976).

It can be seen from this singular distribution pattern that the Nile acted as a barrier to terrestrial and semi-aquatic species from the north, either from the west or from the east, but as an easy route of migration for tropical aquatic and semi-aquatic species. In the case of some other species of European plants and animals, however, we find that strictly Mediterranean plants in the east and west of the Nile Delta are different from each other, so that the Delta acted in this case as a barrier. Meanwhile, Mediterranean plants and animals which are more heat tolerant extend their distribution on the Egyptian coast into a more southerly direction, and thus can cross over the Nile at the level of Cairo, and consequently were able to migrate to the other side of the Delta. This has been called the "Cairo bridge" (Ayyad and Ghabbour 1986). But most of these species came from east to west rather than from west to east.

If we go back to the case of earthworms and their allies, we should know that their movement in the soil is very slow and cannot happen except in moist soil. They also emerge outside of the soil in the rain, especially during the night, and thus can move for relatively greater distances. This is why they are called in German "Regenwürmer". One species of earthworm is even called in America the "night crawler", but this particular one does not occur in North Africa. The point is that there must be a minimum of rainfall in order that earthworms (terrestrial species), can move from one place to another. This minimum is greater, of course, in the case of semiaquatic species, and still greater for aquatic ones, which should need water courses for their migrations, and not only moist soil. It has been calculated from studying the distribution of earthworms in South Africa that the minimum rainfall needed for the cross country movement of earthworms is 500 mm/year. According to these calculations, we must suppose that rainfall at the level of Siwa-Cairo must have reached that minimum during the last Pluvial Period, which lasted for about 70000 years, and ended about 70000 years ago. Hence we can draw up a map of hypothetical rainfall during that last major Pluvial Period, based on this figure,together with some other types of data of climate during that period (after Ghabbour 1996). Had we not discovered these relict species in the Oases of Egypt and Libya, we would never have been able to draw such a map. Using this map, we can estimate the volume of underground water reserves in the Sahara and determine the best rational methods to utilize it. This is an example as good as any; showing how useful is the conservation of relict species in hot spots of the North African desert.

Such occurrences are to be conserved not only for the sake of conserving and maintaining biodiversity, but also because the irreversible loss of these and similar species without their presence being even detected, will make us lose forever valuable information about them. We will thus lose evidence about past climates, their change (a very contemporary issue), and an insight into the probable amounts of rainfall during the last pluvial periods, and hence knowledge about underground water reserves.

The evidence derived from the present distribution of relict earthworms in the oases must be supported or refuted by evidence from other plant and animal species. Such knowledge would undoubtedly be very helpful for the rational development of these resources, so that maintaining biodiversity in the North African desert has much more meaning than elsewhere in temperate or tropical regions. Therefore, the hot spots concept, as applied to our area, should, in our opinion, be extended to include all desert areas where the threat of so-called "development projects" is imminent.

The Case of the Dragonflies

According to Dumont (1980), the Nile, crossing a desert country with greatly thinned out dragonfly populations, drives an "Ethiopian" wedge between the Maghrebian and Levantine "Palaearctic" domains. Evidently, this phenomenon is not limited to dragonflies, but is found in most aquatic groups, such as copepods and fishes, to name only a few. After the Neolithic wet phase, when contemporary conditions emerged, there was no possibility for Palaearctic species to bridge the desert gaps on both sides of the Nile Valley, and Ethiopian species could easily recolonize via the Nile. However, the possibility that relictual Palaearctic populations of dragonflies exist in mountainous areas or oases is not at all improbable. The dragonfly fauna of Egypt consists almost completely of African species, carried north by the Nile. Typical Palaearctic elements are rare, but a fair number of Mesiastic species that are really relicts, are firmly implanted, and three of them extend far into the Sahara, reaching the Hoggar, Aïr and Tibesti mountains, and Jebel Marra in western Sudan. It is noteworthy that while only one Ethiopian species has been found in Giarabub Oasis, there is an important Ethiopian element surviving in the "Maghreb". This anomaly could be due to extinction of species in the oases. The narrower the geographic area of the habitat, the greater are chances of extinction of species within large species assemblages.

An Example of Methodology

Williams et al. (1996) presented a method for the identification of two types of hot spots of diversity of British birds: richness hot spots and rarity hot spots, together with complementary areas for their conservation. Biodiversity conservation requires efficient methods for choosing priority areas for in situ conservation management. These authors therefore compared three quantitative methods for choosing 5% (an arbitrary figure) of all the 10x10 km grid cells in Britain to represent the diversity of breeding birds: (1) hot spots of richness, which selects the areas richest in species; (2) hot spots of range-size rarity (narrow endemism), which selects areas richest in those species with the most restricted ranges; and (3) sets of complementary areas, which selects areas with the greatest combined species richness. Complementary refers to the degree to which an area contributes otherwise nonrepresented species to a set of areas. As a concept it is independent of spatial scale, although actual numbers of complementary species are not.

The results of applying the three methods show that richness hot spots contain the highest number of species-in-grid-cells records (with many representations of the more widespread species), whereas the method of complementary areas obtained the lowest number. However, whereas richness hot spots included representation of 89% of British species of breeding birds, and rarity hot spots included 98%, the areas chosen using complementarily represented all the species, where possible, at least 6 times over. The method of complementary areas was also well suited to supplementing the existing conservation network. For example, starting with grid cells with over 50% area covered by existing "Sites of Special Scientific Interest," the authors searched for a set of areas that could complete the representation of all the most threatened birds in Britain, the Red Data species. The method of complementary areas distinguishes between irreplaceable areas on one hand, and flexible areas, on the other hand, which helps planners by providing alternatives for negotiation. This method can also show which particular species justify the choice of each area. Yet the complementary areas method will not be fully able to select the best areas for conservation management until the decision makers achieve integration of some of the more important factors affecting viability, threats, and costs.

Recommendations

The following recommendations are proposed for the conservation of biodiversity in the five countries of North Africa participating in a regional programme. They are to be launched all at one time and not consecutively:

1 - Starting a literature survey for the geographic distribution of plant and animal species of the deserts of North Africa, with particular reference to areas with permanent or intermittent moisture, such as: oases, depressions, mountain tops, coastal areas, wetlands, etc.

2 - Definition of the concept of hot spots of the deserts of North Africa by establishing criteria of rarity, endemism, economic value, type and degree of threat, and availability of protection facilities (financial, legal, personnel, etc.).

3 - Establishing a regional data bank for hot spots of the five North African countries, to be supplemented by a GIS and Gap Analysis facilities. In this step, the cooperation of the Arab League Educational, Cultural, Scientific Organization (ALECSO), the Blue Plan for the Mediterranean, IUCN World Conservation Monitoring Center (Cambridge, U.K.), the Secretariat de la Faune et de la Flore (SFF) at the Museum National d'Histoire Naturelle (MNHN) in Paris, as well as the Biosphere Reserves Network of UNESCO and the World Heritage Convention Center (WHC) also at UNESCO, Paris, will be imperative.

4 - From the above steps, hot spots that need immediate protection will be identified, and orders of priority for the others will be set forth.

5 - Continuous programmes of monitoring and of awareness campaigns will be designed for both the general public and decision makers, in order to ensure that protection measures are officially taken, and to obtain public support for such measures.

6 - Programmes for the optimal and sustainable utilization of the biodiversity of the identified hot spots, whether or not protected, will be designed, to promote education, economic non-destructive benefits, scientific research, training, etc.

7 - A Red Data Book of Endangered Scientifically Interesting Sites (ESIS) as well as annual or biennial reports on their status, will be published.

8 - The hot spots, whether actually protected or only identified as such, of the five North African countries, will be joined together in a Regional North Africa Network of Scientifically Interesting Sites, to strengthen cooperation among them and with international organizations, notably the IUCN.

9 - Establishing a North African Regional Natural History Museum for the biota of the North African desert, in one of the North African countries, with the cooperation of European Natural History Museums having collections from North Africa (Paris, London, Tervuren, Vienna, Turin, etc.).

10 - Arranging for short and long duration training missions for young scientists from the countries of North Africa in taxonomy, museology, database techniques, etc., in European countries where such expertise is available, and facilitating the participation of these young scientists in training courses organized by international institutions in these domains, within North African countries.

References

Ahmad, M. F. and Hussein, H. S. (1994) Seasonal variations in species diversity pattern at the Mediterranean coastal desert of Egypt. *J Union Arab Biol.* 1 B: 163- 182.

Allard-Huard, L. (1994) Les secteurs rupestres du sous-continent saharien et du Nil. *Les Dossiers d'Archèol.* 197: 70-83.

Anderson, S. H.; Beiswenger, R. E. and Purdom, P. W. (1993) *Environmental Science.* 4th ea., MacMillan, New York: 488 pp.

Aniskowicz, B. T. (1995) The neglected majority continues to struggle for recognition. *Global Biodiv.* 5: 4-7.

Ayyad, M. A. and Fakhry, A. (1994) Species diversity in the plant communities of the coastal dunes of the western Mediterranean coastal desert of Egypt. *J Union Arab Biol.* 1B: 73-87.

Ayyad, M. A. and Ghabbour, S. I. (1986) Hot deserts of Egypt and the Sudan. In: *Ecosystems of the World, Hot Deserts and Arid Shrublands*, vol. 12B, ed. D. W. Goodall et al., Elsevier, Amsterdam: 149-202.

Barakat, H. (1995) The date palm grove oasis, a North African agro-ecosystem. In: *Conserving Biodiversity Outside Protected Areas. The Role of Traditional Agro-Ecosystems*, eds. P. Halladay and D. Gilmour, IUCN, Gland, and Cambridge: 136 - 152.

Batanouny, K. H. (1995 a) Loss of biological diversity in Egypt a vital concern. *Diversity* 11: 5152.

Batanouny, K. H. (1995 b) Biological diversity in the Arab World. Plenary paper presented at: *Biological Diversity, Its Conservation and Sustainable Use in the Arab World*, Bahrain, 12-14 Dec. 1995: 25 pp. (typescript).

Batanouny, K. H. and Ghabbour, S. I. (1995) *The conservation of centres of biological diversity in arid North Africa, hot spots.* IUCN: 3 pp. (typescript).

Batanouny, K. H. and Ghabbour, S. I.(1996) *Arid Lands Biodiversity in North Africa, Proceedings Workshop on Arid Lands Biodiversity in North Africa*, Meeting of National IUCN Committees of North African Countries, Cairo, Nov. 1994, Egyptian IUCN Committee (Acad. of Sci. Res. and Techn.) and IUCN, Cairo: 139 pp. (Eng.) +7 pp (Ar).

Bousquet, B. (1992) *Guide des Parcs Nationaux d 'Afrique, Afrique du Nord, Afrique de l 'Ouest.* Delachaux et Niestlè, Neuchatel and Paris: 368 pp.

Cailleux, A. (1953) *Biogè ographie Mondiale*. Que Saisje? Presses Univ. be France, Paris: 126 pp.

Cloudsley-Thompson, J. L. (1969) *The Zoology of Tropical Africa.* Weidenfeld and Nicholson London: 355 pp.

Dumont, H. (1980) The dragonfly fauna of Egypt and the role of the Nile in its origin and composition. *Water Supply & Mngt.* 4: 29-34.

Ghabbour, S. I. (1976) The faunal relations of Oligochaeta in the Nile Basin. In: *The Nie: Biology of an Ancient River,* ed. J. Rzoska, W. Junk, Publ., the Hague: 117-125.

Ghabbour, S. I. (1996) Soil fauna biodiversity in arid lands of North Africa. In: *Arid Lands Biodiversity in North Africa, Proc. Workshop on Arid Lands Biodiversity in North Africa,* Nov. 1994, Cairo, Egyptian IUCN Committee (Aced. of Sci. Res. & Techn.) and IUCN, Cairo: 73-89.

Huston, M. A. (1994) *Biological Diversity, The Coexistence of Species on Changing Landscapes.* Cambridge Univ. Press: 681 pp.

Le Houèrou, H. N. (1995) Considerations biogeographiques sur les steppes arides du nord de l'Afrique. *Sécheresse* 6: 167-182.

Margules, C. R.; Nicholls, A. O. and Pressey, R. L. (1988) Selecting networks of reserves to maximise biological diversity. *Biol. Conserv.* 43: 63-76.

Myers, N. (1990) The biodiversity challenge: Expanded hot-spot analysis. *The Environmentalist.* 10: 243-256.

Noss, R. (1990) Indicators for monitoring biodiversity: A hierarchical approach. *Conserv. Biol.* 4: 355-364.

Pasteur, G. and Bons, J. (1959) *Les Batraciens du Maroc.* Trav. Inst. Sci. Chérifien, Sér. Zool., Rabat: 241 pp. + 3 pls. and map.

Pearce, D. and Moran, D. (1994) *The Economic Value of Biodiversity.* Earthscan, London: 172 pp.

Scott, J. M.; Davis, F.; Csuti, B.; Noss, R.; Butterfield, B.; Groves, C.; Anderson, H.; Caicco, S.; D'Erchia, F.; Edwards Jr., Th. C.; Ulliman, J. and Wright,R.G. (1993) GAP analysis: A geographic approach to protection of biological diversity. *Wildlife Monogr.* 123: 41 pp.

Soulé, M. E. and Kohm, K. A. (1989) *Research Priorities for Conservation Biology.* Society for Conservation Biology, Island Press, Washington, D.C.: 97 pp.

Williams, P.; Gibbons, D.; Margules, Ch.; Rebello, A.; Humphries, Ch. and Pressey, R. (1996) A comparison of richness hot spots, rarity hot spots, and complementary areas for conserving diversity of British birds. *Conserv. Biol.* 10: 155-174.

النقاط الساخنة للتنوع الأحيائى فى شمال أفريقيا

للأستاذ الدكتور سمير إبراهيم غبور

قسم الموارد الطبيعية، معهد البحوث والدراسات الأفريقية. جامعة القاهرة

ملخص

تعهدت دول العالم فى اتفاقية صون التنوع الأحيائى واستخدامه استخداما متواصلا، والتى وقعت فى مدينة ريو دى جانيرو بالبرازيل أثناء انعقاد مؤتمر الأمم المتحدة للبيئة والتنمية (قمة الأرض) فى يونيو عام ١٩٩٢، بأن تصون ما لديها من تنوع أحيائى. وذلك بعد أن تبين أن التنوع الأحيائى هو المادة الخام لصناعات التكنولوجيا الأحيائية الواعدة، وأن ما يفقد من هذا المورد الثمين لايمكن أن يعوض ، لأنه من خلق الله سبحانه وتعالى وليس للإنسان أى دخل فى نشوئه، وأن معدلات الفقد الحالية تفوق بكثير معدلات الفقد فى العصور الماضية. وحيث أن الموارد المالية لمعظم الدول تقصر عن أن تصون كل ما لدى الدولة من تنوع أحيائى فى عموم أراضيها ومياهها الإقليمية ، فقد اتجه الرأى إلى التركيز على ما أطلق عليه « النقاط الساخنة»، و يعنى بها المناطق التى يتركز فيها التنوع وتتهدده فى نفس الوقت أخطار شديدة ناجمة عن تكثيف النشاط الإنسانى وتغوله على هذه المناطق. أى أن النقاط الساخنة مناطق يجب أن تحظى بالأولوية فى إنفاق الاعتمادات الخاصة بصون التنوع الأحيائى. ويفسر تركيز التنوع الأحيائى على أنه قد يكون وجود عدد كبير من الأنواع ، أو أنواعا ذات أهمية خاصة، أو أنواعا متفردة بنسبة كبيرة. وهى معايير استحقاق النقاط الساخنة لحماية أكثر من غيرها. وقد يكون مرجع الأهمية ليس إلى الأنواع فى حد ذاتها، بل إلى تجمعاتها، أى أنها قد تكون « مناطق ذات أهمية علمية أو بيئية خاصة» مثل الشعاب المرجانية أو الأراضى الرطبة أو الغابات، حتى لو كانت أنواعها محدودة العدد وليس من بينها أنواع متفردة .

وتأتى الأخطار التى تتهدد تلك المناطق عادة من امتداد النشاط الإنسانى إليها بطريقة عشوائية لتحويلها إلى مناطق صناعية أو سكنية أو للاستزراع أو لإقامة المنتجعات السياحية، دون النظر إلى ما يحدثة ذلك من تدمير لموائل التنوع الأحيائى. وبالنسبة لدول شمال أفريقيا، التى تتميز بأن معظم أراضيها صحراوية، فإن المساحات المعرضة لتلك الضغوط مساحات حيوية بالنسبة للدولة، إذ أنها هى التى يتاح فيها السكن ويتركز فيها العمران ويتركز فيها النشاط الإنسانى بكل نواحيه. وفى هذه الدول الصحراوية لا توجد الحياة من نباتية أو حيوانية أو إنسانية إلا حيثما يوجد الماء فالحياة الطبيعية (أى تنوعها الأحيائى) فى هذه الدول سهلة الإبادة وتقف على حد السكين، ولا تتحمل المزيد من الضغوط . ويمكن القول بالنسبة لهذه الدول بأن أى منطقة فيها ماء سيكون فيها التنوع الأحيائى الممكن وجوده فى مثل ظروفها، فهى بالتالى نقطة ساخنة، أو يتحتم أن تعتبر كذلك .

لذلك من الأهمية بمكان توعية الرأى العام والمسئولين بأن الأخطار التى تتهدد التنوع الأحيائى فى تلك النقاط الساخنة تتهدد البشر أنفسهم وتتهدد خطط التنمية، وربما الأهم من ذلك لأنه أقرب، تحجر على إمكانيات الانطلاق فى بحوث التكنولوجيا الأحيائية. فالتأثيرات السلبية متبادلة ويجب وقفها فى مرحلة ما، ولابد أن تكون هذه المرحلة أقرب ما يمكن .

وتعرض الورقة برنامجا متعدد النقاط يمكن أن تتعاون فى تنفيذه دول شمال أفريقيا للقيام بواجب صون النقاط الساخنة فيها، خاصة، وتنوعها الأحيائى عامة، لصالح الأجيال القادمة ولصالح التنمية المتواصلة .